WHAT IS CLAIMED IS:

1. A phase shift fringe image analysis method comprising the steps of shifting an object to be observed and a reference relative to each other by using a phase shift device, obtaining fringe image data at a plurality of phase shift positions, and determining a phase of said object by analyzing thus obtained plurality of fringe image data items;

wherein said plurality of phase shift positions are at least three phase positions having a given phase gap therebetween; and

wherein positional data of said at least three phase positions are specified, and the whole or part of said fringe image data on which carrier fringes at said phase positions are superposed is subjected to a predetermined arithmetic operation so as to carry out a phase analysis and determine said phase of said object.

2. A phase shift fringe analysis method according to claim 1, wherein said positional data of said at least three phase positions are determined by a Fourier transform fringe analysis method.

3. A phase shift fringe analysis method according to claim 1, wherein said predetermined arithmetic operation is carried out in view of data concerning relative tilt between said object and said reference at said at least three phase positions.

4. A phase shift fringe analysis method according to claim 3, wherein said data concerning relative tilt between said object and said reference is determined from a difference in frequency of said carrier fringes.

5. A phase shift fringe analysis method according to claim 3, wherein said data concerning relative tilt between said object and said reference is determined from a difference in phase of said object.

6. A phase shift fringe analysis method according to claim 1, wherein the number of phase shift positions for determining said fringe image data is 3, and wherein said phase of said object is represented by the following conditional expression (1):

$$\phi(x,y) = \arctan \frac{\cos\delta_3 - (1+p)\cos\delta_2 + p\cos\delta_1}{\sin\delta_3 - (1+p)\sin\delta_2 + p\sin\delta_1} \tag{1}$$

where

$$p = \frac{i_3 - i_2}{i_2 - i_1} = \frac{\cos[\phi(x,y)+\delta_3] - \cos[\phi(x,y)+\delta_2]}{\cos[\phi(x,y)+\delta_2] - \cos[\phi(x,y)+\delta_1]}, \text{ and}$$

$$\begin{aligned} i_m(x,y,\xi_m) &= a(x,y) + b(x,y)\cos[2\pi f_{xm}x + 2\pi f_{ym}y + \phi(x,y) + \xi_m] \\ &= a(x,y) + b(x,y)\cos[\phi(x,y) + \delta_m] \end{aligned}$$

where

a(x, y) is the background of interference fringes;

b(x, y) is the visibility of fringes;

ϕ (x, y) is the phase of the object; and

δ_m is the phase shift amount of the phase shift device expressed by:

$$\delta_m = 2\pi f_{xm}x + 2\pi f_{ym}y + \xi_m$$

where

ξ_m is the phase of the phase shift device (not including the part involved with the tilt of the phase shift device); and

f_{xm} and f_{ym} are the carrier frequencies (including the part of the error in inclination of the phase shift device) after the m-th phase shift expressed by:

$$\xi_m = 2\pi \frac{z_m}{\lambda}, \quad f_{xm} = \frac{2 \cdot \tan\theta_{xm}}{\lambda}, \quad f_{ym} = \frac{2 \cdot \tan\theta_{ym}}{\lambda}$$

where

λ is the wavelength of light;

θ_{xm} and θ_{ym} are respective inclinations of the object surface upon the m-th phase shift in x and y directions; and

z_m is the amount of displacement of the phase shift device at the m-th shift position (not including the part involved with the tilt of the phase shift device).

7. A phase shift fringe analysis method according to claim 1, comprising the steps of determining a complex amplitude of a fringe image by said Fourier transform fringe analysis method, and obtaining said at least three phase

positions according to thus determined complex amplitude.

8. A phase shift fringe analysis method according to claim 1, comprising the steps of selecting a plurality of sets of at least three local fringe image data items corresponding to each other from fringe image data at said at least three phase shift positions, obtaining positional data of said at least three phase positions concerning each set according to said fringe image data of respective set, and averaging positional data of phase positions by a number corresponding to the number of said sets, so as to determine final positional data of said at least three phase positions.

9. A phase shift fringe analysis method according to claim 1, wherein said fringe image is an interference fringe image.

10. A phase shift fringe analysis apparatus for shifting an object to be observed and a reference relative to each other by using a phase shift device, obtaining fringe image data at a plurality of phase shift positions, and analyzing thus obtained plurality of fringe image data items so as to determine a phase of said object;

wherein said plurality of phase shift positions are at least three phase positions having a given phase gap therebetween; and

wherein said apparatus comprises data acquiring means for obtaining positional data of said at least three phase positions, and phase analysis means for carrying out a phase analysis by subjecting the whole or part of said fringe image data on which carrier fringes at said phase positions are superposed to a predetermined arithmetic operation.